

winter, which seems to show that convection and turbulence are equally strong in the two seasons.

The fall of temperature is greater in depressions than in anticyclones because in the first case convection is more active. For the same reason, the decrease of temperature in anticyclones is greater in summer than in winter.

The correlation coefficients between pressure and temperature, calculated by Dines from soundings in England, gave high positive values, that is to say, high pressures correspond to high temperatures. The results obtained by us are quite different. (See following table.)

Seasons (levels)	Means		Standard deviations		Correlation coefficients	Probable errors
	Pressure	Temperature	Pressure	Temperature		
Summer:						
Surface.....	1,008.9	28.8	3.1	2.9	-0.26	±0.08
2,000 m. s. l.....	804.6	16.2	2.1	2.8	+0.23	±0.08
4,000 m. s. l.....	633.7	5.9	2.1	1.7	+0.42	±0.10
Winter:						
Surface.....	1,017.6	22.7	4.2	2.7	-0.55	±0.06
2,000 m. s. l.....	808.1	11.9	2.4	3.3	-0.03	±0.08
4,000 m. s. l.....	634.2	2.6	3.1	3.5	+0.91	±0.03

From an examination of the mean values we may conclude that in winter the surface pressure is normally 8.7 mb higher than in summer. The difference becomes 3.5 mb at 2,000 m, and 0.5 mb at 4,000 m.

Pressures higher in winter than in summer are common above the continents at low levels, on account of the warming of the surface during the latter season.

In summer, however, at very high levels, the heating is less and therefore the fall of pressure is also less than at the surface.

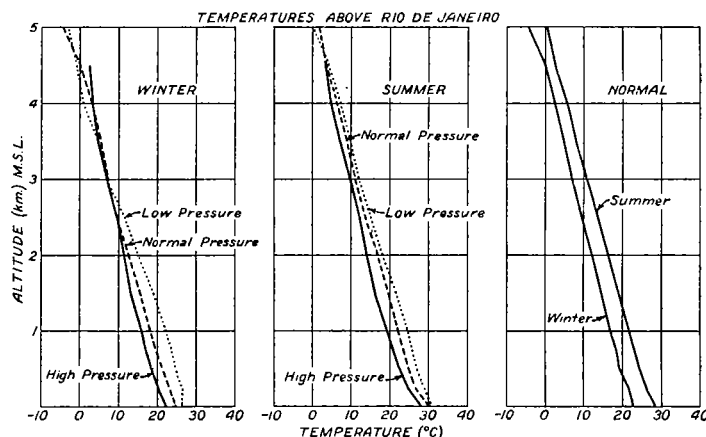
The standard deviations of pressure are higher in winter than in summer, because in winter there is great activity in the passage of depressions and anticyclones, while in summer this is weakened.

The decrease in the standard deviation at high levels seems to indicate that the original oscillations of pressure are amplified at low levels by the effect of the surface tem-

perature. It also indicates that cyclones and anticyclones reach at least 4,000 m.

The standard deviations of temperature are higher in winter on account of the great activity of the secondary circulation, with consequent frequent passages of air masses with different temperatures.

The significance of the correlation coefficients is somewhat uncertain. There is, perhaps, positive correlation at 4,000 m in summer (+0.42), that is, high pressure at 4,000 m corresponds to high temperature. However, having seen that high temperatures correspond to low pressures at the surface, we may conclude that depres-



sions at the surface have, at 4,000 m, relatively high pressure, and vice versa. This conforms to the classic theory that depressions are formed by local heating.

There is also a negative correlation coefficient (-0.55) at the surface in winter (depressions warmer than anticyclones.) At 4,000 m there is a very high positive coefficient (+0.91), already explained, and similar to those obtained in the Northern Hemisphere. This means that at that level, in winter, surface depressions are still depressions, and not anticyclones.

At the other levels there appears to be no correlation at all; probable errors are generally small.

These notes are the first study of upper-air temperatures in South America.

CLOUD PHOTOGRAPHY AT THE MANILA OBSERVATORY

By Rev. C. E. DEPPERMAN, S. J., Assistant Director

[Philippine Weather Bureau, Manila, May 1935]

In order to correlate clouds with the various types of air currents that reach the Philippines, the Manila Observatory in May 1934 started a year's photography of clouds. Now that the program has been successfully completed, a few words as to the plan of campaign and the results achieved may be of interest.

It was quite a problem to decide upon the best method of procedure. Many have advocated the use of a cylindrical or "fish-eye" lens, of the type suggested by Wood in his Physical Optics, or at least some very-wide-angle lens, to enable the photographer to cover most of the sky in one picture. This would be an advantage, of course, if it could be done cheaply and efficiently. However, a lens of this type would be very expensive, and a special shutter would be imperative to get proper distribution of light intensity. Experience, moreover, has shown the writer that the sky very often shows remarkable contrasts in light intensity, especially in stormy weather, and no shutter would be equal to the task of bringing

out properly all parts of the sky in one picture. Even with an ordinary camera, with its limited field of view, certain pictures have to be consistently rejected, unless the photographer when printing is prepared for the task of delicate "dodging", i. e., of shading parts of the negative. To take several pictures at a time of ordinary size, say 4 by 5 inches, or 5 by 7 inches, and select characteristic parts of the sky, is another alternative, but the cost would be very high, if one wishes, as I did, to take some 20 or more pictures a day, and often, in striking situations, 5 or 6 in rapid succession. The frequent loading of the ordinary rolls of 6 or 8 pictures would also be very inconvenient.

After much deliberation the following scheme was adopted and has proved quite satisfactory; the cost, though considerable, has not been prohibitive, considering the ambitious nature of the project. A Contax camera was purchased, using movie film, 36 pictures to a roll, but taking a picture twice as large as the ordinary

movie camera. The size is admittedly small, but the definition is excellent, and with the aid of an ordinary reading glass all necessary cloud detail can usually be seen. A diary was kept of exposure times, the general sky and weather conditions at the time of taking the picture, together with positive, actual-size pictures. The diary at the end of the year contained some 5,000 pictures of clouds. Some 600 of the best typical pictures have been enlarged to size 5 by 7 inches.

A few more details will now be given as to the camera and method of procedure:

The camera and lenses.—The camera used was a Zeiss Contax. At first a wide-angle lens was adopted, giving a field of view of about 90° (Zeiss Tessar 1: 8, f. 2.8 cm). However, when a filter was put on (a light yellow one), the wide angle at which the light met the filter caused much reflection, and as a result the outer parts of the picture very often showed serious underexposure. Hence an ordinary Zeiss Tessar (1: 2.8, f. 5 cm) was purchased and has proved very satisfactory in general.

The wide-angle lens was reserved for those pictures of clouds (e. g., large thunderstorms) which occupied too much area for the ordinary lens, but *no filter* was used with it. Usually the wide-angle lens, so used, gave sufficiently good results, but not always.

A light yellow filter was used with the ordinary lens, since trial with a dark yellow filter showed practically no improvement in detail. In fact, the Agfa Panchromatic films could almost be used without filter most of the time.

Films.—In the tropics, one cannot always get the film one desires, and we were compelled to start out with Superpan films. For the natural size small positives, this gave good results; but when enlargements to 5 by 7 inches are in question, or projection on a screen, then the grain of the Superpan becomes quite perceptible. Isopan films were used as soon as they arrived in Manila and these gave a smaller grain. Finally during the last month of work, the Finopan came, which for fineness of grain leaves really nothing to be desired.

Development.—Fine-grain developers of various types were tried, but they all proved unsatisfactory, due to lack of sufficient contrast in the negatives. Delicate cirrus clouds, or misty cloud effects, etc., would not come out properly; the fine details were lost, and many pictures, too many in fact, were quite flat. We therefore perforce had to use a contrast developer; but, alas, this also enlarged the grain. The grain, however, though at times not so pleasing to the eye on 5- by 7-inch enlargements, was not large enough to spoil details, and so for our films Eastman D-11 developer (time 5 minutes, starting at 16° C.) has been almost exclusively used. It was thought better to possess the requisite cloud details with a somewhat larger grain on enlargements

(of course on the small prints there is no trouble about grain), than to have smoothness with flatness and loss of detail. Perhaps in other climates, with clearer air, fine-grain developers would work better. The films in the tropics after development must be very thoroughly washed. Father Doucette, Chief, Meteorological Section of the Observatory, kindly did all the developing of the films, while the writer took the pictures and did all the printing and enlarging. In this way, though it took much time, the cost of the program was considerably reduced.

Printing.—For this, Eastman D-72 developer (home-made as was the D-11, by Father Doucette), diluted to proper proportions (1 part developer to 2 parts water) and Azo No. 5 or No. 3 paper, were used. *Very* thorough washing and the use of hypo *only once* were found necessary to prevent the prints from turning brown after some months.

Enlarging.—To have 5- by 7-inch enlargements made outside would have been very costly, and not so satisfactory, since it would be difficult for another to estimate rightly the proper shade of the clouds. It was found cheaper and much more satisfactory to make the enlargements ourselves, using a Zeiss "Magniphot." To get sufficient contrast on these enlargements, D-11 developer was again used, undiluted, and proved excellent when used in conjunction with News Bromide Contrast paper (or Medium for the more naturally contrasty pictures). With the new Finopan films, enlargements of this size, developed as indicated, give hardly any grain, and show exquisite detail and contrast.

Taking the pictures.—About 20 pictures a day were taken as a rule (the number varying with sky conditions), usually at intervals of 1 or 2 hours. An Ombrux exposure meter, which is reasonable in price and very satisfactory, was found an absolute necessity to gage exposures of clouds correctly. One had to learn, too, not to take pictures too near the sun or with too much contrast; this is especially true for pictures of squalls, storm clouds of various kinds, etc. The eye has a remarkable power of adaptation to varying degrees of light intensity, and only an exposure meter insures consistently good exposure times. This consistency is a necessity, for it must be remembered that the film roll has 36 pictures, and there can be no individual development, and this latter must be done in a tank in perfect darkness, since the films are so very sensitive to light. Even with a yellow filter, the ordinary exposure time used was one one-hundredth second, stop 8.

So much for the method. Now there remains the onerous task of studying the pictures in relation with the weather map. It will, in all probability, be a year or more before the results of such analysis can be published.

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